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The Ebb and Flow of Comparative Advantage: Trade and the Industrial Specialization of Canadian Manufacturing Regions, 1974 to 1999

by W. Mark Brown

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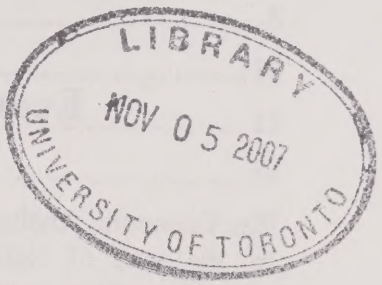

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Abstract

Utilizing a longitudinal micro data file of manufacturing plants (1974 to 1999), this study tests the effect of higher levels of trade on the level of industrial specialization experienced by regional manufacturing economies. Consistent with trade driven by comparative advantage, the analysis demonstrates that higher levels of export intensity (exports as a share of output) across regions are associated with greater industrial specialization. However, the analysis also shows that changes in export intensity are only weakly associated with changes in specialization. This occurs because comparative advantage tends to shift away from industries that account for a large share of regional manufacturing employment and towards industries that initially have lower shares. This ebb and flow of comparative advantage helps to explain why Canadian manufacturing regions have not become more specialized in an environment of increasing integration into the world market.

Keywords: International trade, comparative advantage, regional industrial specialization, manufacturing

Executive summary

Over the past three decades, the Canadian economy has become increasingly integrated into world markets through trade. This growing integration raises questions regarding how trade has affected the Canadian economy. While many analyses to date have focused on the impacts of trade at the national scale, relatively few have analyzed the effects of trade at the regional scale. The purpose of this study is to help fill this gap in our knowledge.

This study focuses on how trade has influenced the level and change in industrial specialization experienced by regional manufacturing economies over a 25-year period (1974 to 1999). Theoretically, trade liberalization should increase the size of those industries that have a comparative advantage in world markets and decrease the size of those that have a comparative disadvantage. In short, increased trade should lead to greater industrial specialization.

Increased industrial specialization creates both benefits and risks. On the one hand, trade driven by comparative advantage should result in a more efficient allocation of resources across industries, increasing productivity. On the other hand, greater specialization increases the risk arising from a significant downturn in the local economy with the loss of one or two key industries.

There are several questions that this paper seeks to answer regarding the link between trade and industrial specialization.

Is there a positive association between the level of trade and the level of industrial specialization of regional economies?

- Across regions, higher levels of export intensity (exports as a proportion of total manufacturing output) are positively associated with higher levels of industrial specialization, after controlling for a series of other factors that influence specialization.

In which regions is the effect of higher levels of trade on specialization strongest?

- The positive association between export intensity and specialization was strongest in the Western and Atlantic provinces, while it was weaker in Ontario and Quebec. Higher levels of export intensity are also more strongly associated with specialization in rural areas than in urban areas.

- The weaker association between trade and specialization in Ontario and Quebec may stem from the fact that a higher proportion of their trade is driven by specialization in particular types of products, rather than specialization across industries.

- The association between export intensity and specialization was stronger in the pre-free trade era (1974 to 1984) than in the post-free trade era (1990 to 1999).

What is the association between growing trade and industrial specialization?

- Canada's manufacturing sector more than doubled its level of export intensity between 1974 and 1999, from 18% to 43%. But this growing integration through trade has not been accompanied by an increase in regional levels of industrial specialization.

- Utilizing a multivariate statistical model to explore further the relationship between changes in export intensity and specialization, the analysis indicates that there is only a weakly positive association between the two variables, holding all other factors constant. This is particularly true of the post-1990 free trade era.

What underlies the weak association between growing trade and industrial specialization?

- Underlying this weak association is the tendency for comparative advantage to ebb in sectors that are relatively important (those with relatively large employment shares) and flow to sectors that are relatively unimportant (those with relatively small employment shares) to regional economies. In short, there is a tendency for export intensity to grow fastest in sectors that are, at least initially, relatively small.

Overall, this study finds a strong and positive association between trade and specialization, particularly outside of Central Canada and urban areas. But it also finds that increased trade does not appear to have resulted in greater specialization, largely because comparative advantage tends to ebb in sectors that were once important to a regional economy and flow to sectors that are only emerging as important sectors. Trade may unleash forces that push regional economies towards greater specialization, but these same forces are undermined by the tendency for comparative advantage to switch from sector to sector.

1. *Introduction*

Over the past three decades, the Canadian economy has become increasingly integrated into world markets. This is the result of successive rounds of tariff cuts under the General Agreement on Tariffs and Trade (GATT), the implementation of the Canada-U.S. Free Trade Agreement (FTA) and, its successor, the North American Free Trade Agreement (NAFTA). With this growing integration, questions are inevitably raised regarding how it has affected the Canadian economy.

Focusing on the impacts of the FTA and NAFTA, many studies have analyzed how trade liberalization has affected the Canadian economy.[1] However, most have emphasized the national impact of trade liberalization. This belies the fact that Canada is composed of a distinct set of regional economies, whose ties to North American and global markets are often quantitatively and qualitatively different. The purpose of this paper is to begin to fill this gap in our knowledge.

The effect of trade on regional economies can be measured across many dimensions. This paper focuses on how trade has influenced the level and change in industrial specialization experienced by regional manufacturing economies. A companion paper asks how trade has differentially affected how production is organized within plants across regions (see Baldwin and Brown, 2007).

There is, of course, a close theoretical link between trade liberalization and industrial specialization at the national scale. Trade liberalization should increase the size of those industries that have a comparative advantage in world markets and decrease the size of those that have a comparative disadvantage. In short, increased trade should lead to greater industrial specialization.

Industrial specialization creates both benefits and risks. On the one hand, trade driven by comparative advantage should result in a more efficient allocation of resources across industries, increasing productivity. On the other hand, greater specialization increases the risk of a significant downturn in the local economy with the loss of one or two key industries.[2]

Theory regarding the effects of trade liberalization on industrial specialization at the regional scale is less well developed than at the national scale, but still instructive. Transposing our expectations regarding the effect of trade liberalization from the national to the regional scale, one would expect those regions that specialized in industries with a comparative advantage in world markets to become even more specialized. Given that most Canadian regions, be they large or small, export part of their manufactured output, we would expect high levels of trade to be associated with higher levels of industrial specialization.

Trade liberalization can also affect industrial specialization indirectly. Fujita, Krugman and Venables (1999) argue falling trade barriers diminish centripetal forces—driven by access to

1. See Schwanen (1997), Head and Ries (1999a, 1999b and 2001), McCallum (1999), Trefler (2004) and Baldwin and Gu (2006).
2. See Baldwin and Brown (2004) for an analysis of the link between trade, specialization and the volatility of employment growth.

consumers and intermediate inputs—that underlie the concentration of population and industries in large and industrially diversified regions. The resulting dispersion of industry may lead to increased industrial specialization.

The economic forces unleashed by trade liberalization that push regions towards greater industrial specialization can be lessened by two factors. First, trade does not always result from industry-level specialization driven by comparative advantage. A significant proportion of Canada's trade with its NAFTA partners is in varieties of goods produced by the same industries (see Brülhart and Thorpe, 2001). This intra-industry form of trade is consistent with specialization in particular varieties of goods (e.g., different types of auto parts) but not with industry-level specialization.[3] The greater the intra-industry share of a region's trade, the lower the effect higher levels of trade will have on its level of industrial specialization.

There is strong empirical evidence that the degree of intra-industry trade with the United States varies considerably from province to province. Intra-industry trade is highest in Ontario and Quebec and lowest in the Atlantic and Western provinces (Brown and Anderson, 1999). Therefore, our expectations are that higher levels of trade will be more strongly associated with higher levels of specialization in the Atlantic Provinces and Western Canada than in Ontario and Quebec.

Second, the forces driving industrial specialization do not play out in a world where the sources of comparative advantage are constant. As technologies change and investments are made in human and physical capital, a region's comparative advantage can shift from one industry to another. Comparative advantage may ebb in one industry and flow to the next. If comparative advantage ebbs in industries with a larger share of local employment and flows to those with a small share, then the effect of increased trade on specialization may be reduced.

There is evidence that the comparative advantage of regions does shift over time from more to less important industries. If we think carefully about the economy of our own city or small town, more often than not the key industries of today were not the same industries 10, 20 or 30 years ago. For instance, 30 years ago Montréal was better known for its textile and petrochemical industries than aerospace and pharmaceuticals. Reinforcing this anecdotal evidence is recent work from the United States that suggests that where industries are concentrated often shifts from place to place (Dumais, Ellison and Glaeser, 2002).

The paper's broad objective is to explore empirically the relationship between trade and specialization. To do so, it approaches the analysis in two ways. The first approach is to ask whether regions that export a larger share of their manufacturing output are more industrially specialized than regions that export a smaller share. If the degree of specialization observed is the result of long-term historical processes, then the first approach serves to test the relationship between trade and long-run levels of specialization. It also serves to identify whether regions that engage more in intra-industry trade experience a weaker relationship between trade and specialization.

3. Theoretically, intra-industry trade is driven by plant-level economies of scale (Krugman, 1980) and/or technological differences that vary from plant to plant (Davis, 1995).

The second approach to the analysis is to ask whether regions that increased their export intensity experienced an increase in their level of industrial specialization. Here the purpose is to test whether the ebb and flow of comparative advantage tends to undercut the ties between trade and specialization. A weak relationship between changes in export intensity and specialization would lend support to the contention that shifts in comparative advantage from industry to industry tend to limit the extent to which higher levels of trade can lead to even more highly specialized regional economies.

The remainder of the paper is organized as follows. In Section 2, the data source and econometric strategy are described. Section 3 provides a description of trends in export intensity and industrial specialization across Canadian regions. Section 4 utilizes a multivariate analysis to examine the cross-sectional relationship between export intensity and industry specialization. Section 5 analyses the effect of changes in export intensity on specialization. Section 6 concludes the paper.

2. *Data and econometric strategy*

The data used for this project are derived from a longitudinal data file that covers the universe of manufacturing plants in Canada from 1973 to 1999. The longitudinal data file is built from both administrative and survey sources, with the primary sources being the Annual Census of Manufactures in earlier years and the Annual Survey of Manufactures or ASM in later years. The survey data are derived from the more detailed long-form questionnaires that are primarily sent to larger plants and the less detailed short-form questionnaires that are mainly sent to smaller plants. For the smallest plants, administrative data from tax records are used to measure sales and employment.

It is only long-form questionnaires that provide information on plant exports. As a result, we restrict the data set to plants that respond to it (long-form plants). In 1999, long-form plants accounted for 82% of plant-based employment and 93% of manufacturing shipments.[4] Therefore, there is little loss of generality by focusing the analysis only on long-form plants.

Long-form plants were asked to report their exports in a selection of years. These years include 1974, 1979, 1984, 1990, 1993, and 1996 to 1999.

The objective of the paper is to examine the links between trade and industrial specialization at the regional scale. Census divisions form the fundamental geographic unit of analysis in this paper. These are geographic units that correspond in most provinces to counties or regional municipalities. In order to ensure that changes in the boundaries of census divisions over time do not influence our results, we utilize a constant 1976 census-division geography.[5]

4. These data are derived from a special tabulation of the Annual Survey of Manufactures.
5. See Brown and Baldwin (2003) for another application of this constant geography, whose construction is described in Baldwin and Brown (2001, Appendix A).

In the analysis, census divisions are classified across two dimensions, with respect to the region in which they belong—Atlantic Canada (Newfoundland and Labrador, Nova Scotia, Prince Edward Island and New Brunswick), Quebec, Ontario and Western Canada (Manitoba, Saskatchewan, Alberta and British Columbia)—and whether they are rural or urban. Urban census divisions are those that fall partially or fully within the boundaries of a metropolitan area[6] that has a population of 50,000 or more persons.[7] All other census divisions are classified as rural.

The export intensity of a census division is defined as the proportion of the value of its total shipments that are exported abroad. Census divisions that have higher export intensities are those with greater integration into world markets. In other research, the height of tariff barriers and their decline over time have been used to measure the extent to which an industry was exposed to decreases in trade barriers over time (see Baldwin and Gu, 2006). Here export intensity is used to provide a more comprehensive measure of trade exposure—because we are interested in this paper in understanding how integration into world markets is related to the industrial characteristics of regions.

Throughout, the analysis investigates the effect of export intensity on industrial specialization. Industrial specialization is defined as the degree to which a region relies on a small number of industries. It is measured using a Herfindahl index:

$$IS_j = \sum_{i=1}^{n} s_{ij}^2, \qquad (1.1)$$

where s_{ij} is the share of employment in region j accounted for by industry i. A higher value of the Herfindahl index indicates that the region specializes in fewer industries. The index obtains a maximum value of 1 when employment is concentrated in one industry and a minimum value of $1/n$ when employment is evenly distributed across all n industries, where n is taken to be the total number of four-digit SIC (Standard Industrial Classification) industries.

The data utilized for this analysis are derived from a panel of census divisions covering selected years. Panel data present a challenge because they combine both cross-sectional and time-series effects, whose influence on the dependent variable may not be the same. In fact, as we have noted above, we have strong reasons to believe that the influence of export intensity on industrial specialization may vary between cross-sectional and time-series specifications.

To capture cross-sectional variation, the following model is estimated using the *between* estimator,

$$\overline{IS}_j = \alpha + \overline{\mathbf{x}}_j\boldsymbol{\beta} + \nu_j + \varepsilon_j, \qquad (1.2)$$

6. We define metropolitan areas (Census Metropolitan Areas and Census Agglomerations) using the 1976 geographic boundaries provided by the census.
7. This is based on the 1976 population of these metropolitan areas.

where $\mathbf{x}_j$ and $\boldsymbol{\beta}$ are vectors of variables and parameters, respectively, v_j is an unobserved census division-specific fixed effect, and ε_j is an error term. A bar over a variable indicates it has been averaged across time. By averaging each variable across time we eliminate any time series variation from the analysis, while capturing the average long-run characteristics of census divisions.

To capture variation in the dependent and independent variables over time we first-difference our variables:

$$IS_{jt} - IS_{jt-\tau} = \alpha_t - \alpha_{t-\tau} + \left(\mathbf{x}_{jt} - \mathbf{x}_{jt-\tau}\right)\boldsymbol{\beta} + \varepsilon_{jt} - \varepsilon_{jt-\tau}, \qquad (1.3)$$

where t indexes time and τ is the length of time between the beginning and end points. The first-differencing framework allows us to estimate the effect of change alone. Note that first-differencing also eliminates any bias potentially introduced by the fixed effect v_j present in (1.2).

3. *Data description*

As noted above, integration into world markets can result in higher levels of industrial specialization experienced by regional economies. A descriptive analysis of the trends in export intensity and specialization across Canadian regions is presented here that will serve as a point of departure for the multivariate statistical analysis developed in Sections 4 and 5.

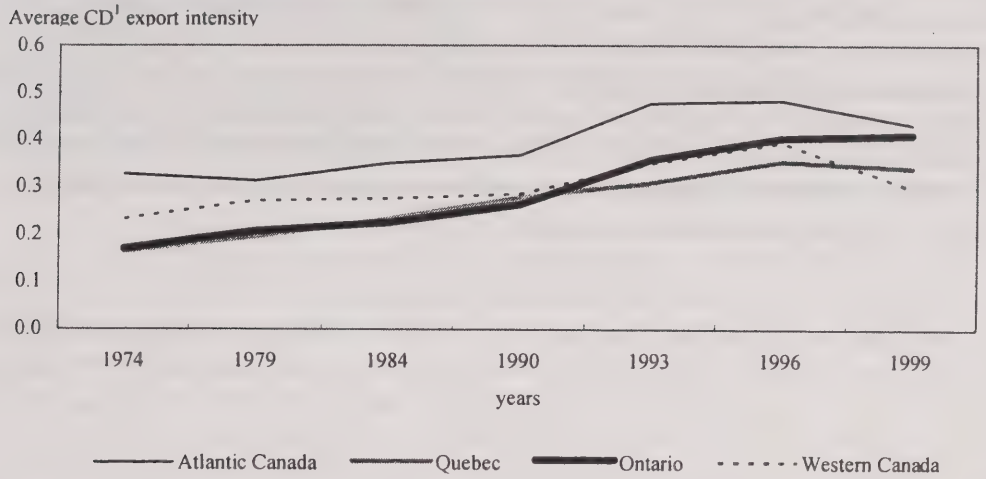
Over the past quarter century, Canadian manufacturing plants have become increasingly integrated into world markets. The export intensity (exports divided by sales) of the manufacturing sector as a whole more than doubled over a 25-year period—increasing from 0.18 in 1974 to 0.43 in 1999.[8]

Across regions, the average export intensity of census divisions followed this broad pattern, but with some regional differences. Census divisions in Atlantic Canada and Western Canada started the period with average export intensities that were above census divisions in Ontario and Quebec (see Figure 1). Over time, however, the export intensity of census divisions in Ontario and Quebec increased at a faster pace than those in Atlantic Canada or Western Canada. The overall picture that emerges is of a manufacturing sector that has become increasingly integrated into world markets, especially Canada's industrial heartland of Ontario and Quebec.

It is noteworthy that Western Canada's export intensity declined significantly between 1996 and 1999. This was likely due to the Asian financial crisis in 1997, which led to declining demand for Western Canada's resource-based exports.

8. These data are derived from a special tabulation of the Annual Survey of Manufactures.

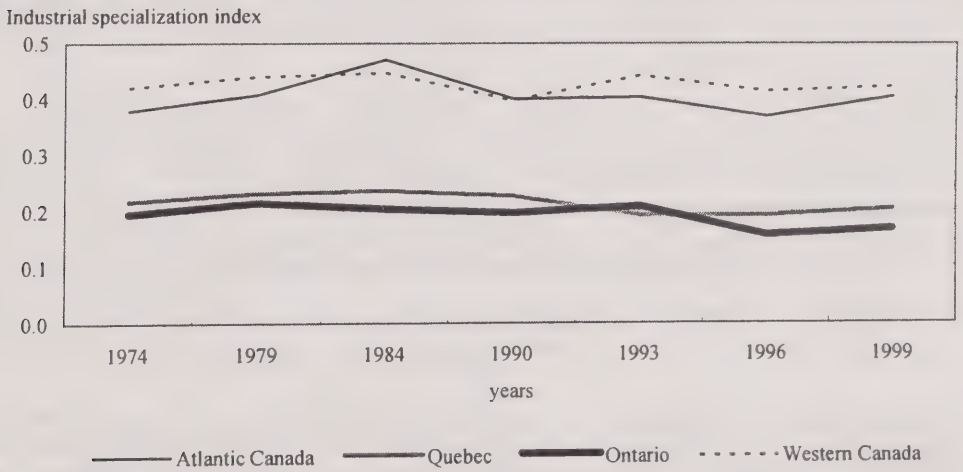
Figure 1
Average export intensity across census divisions, by region, 1974 to 1999



1. Census division.
Source: Statistics Canada, Annual Survey of Manufactures, special tabulation.

Figure 2 presents the industrial specialization index averaged across the census divisions for the same four regions presented in Figure 1. Over the study period, the manufacturing economies of census divisions in Atlantic and the Western Canada were about twice as specialized as those in Ontario and Quebec. The figure also illustrates that, although there was some variability in the degree of specialization found in Atlantic Canada and the Western Canada over time, there was no apparent upward or downward trend in their levels. On the other hand, a general but weak decline in the degree of specialization (increase in diversification) of census divisions in both Quebec and Ontario is observed, with both having lower levels of industrial specialization at the end of the period than at the beginning.

Figure 2
Average census division industrial specialization index, by region, 1974 to 1999



Source: Statistics Canada, Annual Survey of Manufactures, special tabulation.

Taken as a whole, there are two curious aspects of Figures 1 and 2. First, the positive association between export intensity and specialization apparent at the beginning of the study period disappeared by the end. In 1974, those regions whose census divisions were, on average, the most export intensive were also the most industrially specialized. Yet, by 1999 this pattern no longer held—Ontario was the second most export intensive but the least specialized, while Western Canada was the least export intensive but the most specialized. Second, even though the export intensity of census divisions across all regions increased over the study period, there was no discernable increase in specialization. As note above, for some regions the average specialization of their census divisions actually fell.

It might be tempting to stop here and conclude that there is no relationship between trade and industrial specialization, either across regions or over time. But, as the more detailed multivariate analysis that follows will show, there is a strong but nuanced relationship between trade and specialization.

4. Cross-sectional analysis

Trade in all of its forms is driven by the benefits of specialization. Specialization can occur at the level of industries and it can also occur at the level of plants and firms. Industry-level specialization is often associated with comparative advantage driven by differences in factor endowments (land, labour and capital) across countries,[9] while plant-level specialization is often attributed to the exploitation of scale economies.[10] Increases in trade do not necessarily lead to increases in industrial specialization.

As was noted in the introduction, the pattern of trade between Canadian and U.S. regions suggests there may be considerable variation in the type of specialization (intra-industry versus inter-industry). Upwards of 30% to 40% of Ontario and Quebec's trade with U.S. regions is of the intra-industry type, while typically less than 15% of trade between Atlantic Canada, Manitoba-Saskatchewan and Alberta-British Columbia and U.S. regions is intra-industry trade (Brown and Anderson, 1999). Hence, a larger share of Ontario and Quebec's trade, compared with that of Atlantic and Western Canada, is consistent with plant-level specialization (rather than industry-level specialization).

Krugman's (1991a, 1991b) core-periphery model can help to explain why we observe variation in the kind of specialization experienced by regions. Krugman's model is driven by two centripetal forces and one centrifugal force. The centripetal forces relate to the savings on transportation costs that consumers and firms gain from locating in the core. The centrifugal force relates to the higher costs of servicing peripheral markets from the core. In this model, as transportation costs fall, industries whose firms experience economies of scale and do not rely on a factor of production that is fixed in space, will tend to concentrate in the core. Krugman

9. Industry-based comparative advantage may also result from Ricardian technological differences and/or localization economies. Our discussion focuses on factor-based comparative advantage because this is the most likely underlying cause of Canadian trade in natural resource-based products, which continue to account for a significant proportion of Canadian manufactured exports (e.g., softwood lumber).
10. Plant-level specialization can also be attributed to (Hicks neutral) technological differences (Davis, 1995).

identifies a 'sorting' mechanism whereby industries that rely on increasing returns to scale become geographically concentrated in the core, while industries that rely on factor advantages that are fixed in space locate in the periphery.

Although Krugman's core-periphery model is highly stylized, it is a useful starting point to explain Canada's economic geography and the pattern of trade-induced specialization it implies. As the Canadian economy industrialized and transportation costs fell, the manufacturing sector increasingly concentrated in cities and, in particular, the cities of Central Canada (Ontario and Quebec). Industries that relied on being close to their raw material inputs remained in rural regions, while industries oriented towards consumer markets migrated to or developed in the cities.

The pattern of location implied by the Krugman model suggests trade liberalization would have been expected to affect Canadian regional economies in different ways. Our expectation would be that falling barriers to trade would have facilitated increases in trade in products that relied on resource endowments in the peripheral regions, possibly resulting in greater specialization. It would also have permitted the attainment of greater scale economies in Central Canada. The latter may not have led to as much industrial specialization as for peripheral regions.

The industries that concentrated in central Canada may have been amenable to the exploitation of scale economies that resulted from specialization in the production of particular varieties of goods. For instance, as a result of the Auto Pact, Canadian car plants reduced the number of models built in their plants. Trade increased as different varieties of cars crossed the border (intra-industry trade) and there was no concomitant increase in the level of industrial specialization. The fact that we observe higher levels of intra-industry trade for Ontario and Quebec is consistent with this explanation. However, this is not the only explanation for why we might see less specialization in Central Canada resulting from increased trade.

Central Canada was a region whose factor endowment might have led some industries to decline after trade liberalization. But it also possessed industries whose cost disadvantage in world markets was driven by the inability to exploit economies of scale. It is important to keep in mind that while Canada, and especially Central Canada, developed in a similar way to the United States, its industries did not obtain the scale that was obtained in the United States. Canadian plants during much of the post-war period were smaller than in the United States with shorter production-run lengths (Daly, Keys and Spence, 1968; Spence, 1977; and Caves et al., 1980). Increased integration with world markets was predicted to reduce this disadvantage. If the capability to take advantage of scale economies were inversely correlated with factor endowment disadvantages across industries, these two forces would have operated in opposite directions. That is, if cost disadvantages owing to factor endowments were offset by cost economies resulting from increasing plant size, there may have been less of an effect of integration on industrial specialization.

4.1 Definition of independent variables

The primary objective of this paper is to model the effect of variation in export intensity on the level of industrial specialization of regional economies, be they census divisions or larger regions that span provinces. To do so, the model incorporates other variables that will help to provide a

more complete understanding of the factors that influence the industrial specialization at the regional scale.

The descriptive analysis indicated that the level of industrial specialization of the average census division varied across provincial regions. To control for, and measure these regional effects, we include regional binary variables in the model (Atlantic Canada, Quebec, and Western Canada), with Ontario excluded in order to avoid perfect multicollinearity.

The size of a local manufacturing economy is likely to influence its degree of specialization. This is because larger manufacturing economies generate demand for intermediate inputs across a wide variety of upstream industries, which result in greater industrial diversity (less specialization). Furthermore, the size of the local manufacturing economy reflects, in part, the size of the local market for finished products (Christaller, 1933; and Fujita, Krugman and Venables, 1999). As markets become larger, they are able to support a wider variety of locally manufactured products.

Included in the model are three variables that explicitly control for the size of the local economy. Firstly, these include the level of manufacturing employment (Employment). In addition to the level of manufacturing employment, we also control for size by adding a binary variable for whether a census division is urban (Urban)—that is, it is associated with a census agglomeration or census metropolitan area of greater than 50,000 persons.[11] This variable is meant to capture the effect of local consumer demand on the industrial diversity of the census division. Urban is interacted with Employment (Employment × Urban) to account for any non-linear effect of employment on specialization that might be associated with the size of the local market as captured by the Urban variable. Finally, included in the model is the market potential of each census division industry i in census division j, which is defined as:

$$MP_{ij} = \sum_{k} Y_{ik} d_{jk}^{\beta} \exp^{\alpha CANUS} \qquad (1.4)$$

where Y_{ik} is the final demand[12] for the output of (2-digit) industry i in region (census division or U.S. county) j, d_{jk} is the distance between regions j and k and CANUS is a dummy variable for whether the region pair includes a U.S. county. The parameter estimates for β and α are derived from the industry-level gravity models estimated in Brown and Anderson (2002). To obtain the overall market potential for each census division, the market potential of industries are added together.

Included in the model are a set of variables that account for export intensity. The first variable measures the level of export intensity of census divisions (Export intensity). The remaining variables are a set of interaction terms that allow the effect of export intensity on specialization

11. This classification of census divisions is based on the Beale rural/urban classification system, which is described in detail in Baldwin and Brown (2001).
12. This demand for each 1987 United States SIC (Standard Industrial Classification) two-digit manufacturing sector is estimated using the U.S. 1987 Benchmark input-output accounts applied to both Canadian census divisions and U.S. counties.

to vary across rural and urban areas (Export intensity × urban) and regions (Export intensity × Atlantic Canada, Export intensity × Quebec and Export intensity × Western Canada). As outlined above, export intensity may have a differential effect on the level of industrial specialization of regions.

The effect of trade may be felt on plant structure, in addition to inter-industry specialization (Baldwin and Gu, 2006 and Baldwin and Brown, 2006). And the two may be related. Increases in plant size allow the exploitation of scale economies. In turn, these may enhance the move to greater industrial specialization, particularly in smaller manufacturing regions. To control for this, we include the average plant size of exporters (Exporter size). This allows us to better isolate the effect of trade on industry specialization driven by industry-based comparative advantage, rather than specialization driven by larger plant sizes resulting from scale economies.

Finally, we include in the model several controls for industry. Industry controls take the form of employment shares of five sectors—Labour-intensive, Natural resource, Scale-based, Product-differentiated and Science-based industries. Labour-intensive industries are those with low capital–labour ratios, low wages and considerable import competition. Natural resource-based industries are those that have relatively low value added relative to their inputs—industries like food processing that depend on agricultural materials. Scale-based industries have large plants, high capital–labour ratios and economies of scale. Product-differentiated industries have high advertising to sales ratios and produce a larger number of products per plant. Science-based industries have a relatively large white-collar work force and focus on research and development.[13]

4.2 Model results

The results of the between estimator models are presented in Table 1. In the first model, we only include region binary variables. They confirm what we observed in the descriptive analysis. Census divisions in Atlantic Canada and Western Canada have higher levels of industrial specialization than Ontario, while census divisions in Quebec are not significantly different.

Of course, the variation that we observe in specialization across regions may be due to differences in the size of their local economies. We attempt to control for size initially by including in the model measures of the size of manufacturing employment and whether the census division is urban or rural (see Model 2). The coefficients on Employment and Urban are negative and statistically significant, while the coefficient on Employment × Urban is positive and significant. Since the sum of the coefficients on Employment and Employment × Urban is effectively zero, the effect of higher levels of manufacturing employment in urban areas is negligible. In total, these parameter estimates suggest specialization is less in urban areas and in rural regions where manufacturing employment is higher. Hence, there is a negative association between the size of the local economy—as measured by manufacturing employment or urbanization—and specialization, which accords with theory.

13. For a fuller description of these sectors, see Baldwin and Rafiquzzaman (1995).

Table 1
Industrial specialization models, between estimator

	Model 1		Model 2		Model 3		Model 4		Model 5	
	Coefficient	P-values	Coefficient	P-values	Coefficient	P-values	Coefficient	P-values	Coefficient	P-valu
Intercept	0.1526	<0.001	0.3379	<0.001	0.4638	<0.001	0.2301	<0.001	0.2179	<0.00
Atlantic Canada	0.2197	<0.001	0.1134	0.003	0.0565	0.161	0.0592	0.062	-0.1392	0.00
Quebec	0.0434	0.086	-0.0163	0.496	-0.0555	0.024	0.0073	0.683	0.0205	0.54
Western Canada	0.1653	<0.001	0.0696	0.051	-0.0074	0.839	0.0017	0.910	-0.1294	0.00
Urban			-0.2266	<0.001	-0.1977	<0.001	-0.1849	<0.001	-0.0934	0.00
Employment			-0.0330	<0.001	-0.0233	<0.001	-0.0290	<0.001	-0.0273	<0.00
Employment × Urban			0.0323	<0.001	0.0231	<0.001	0.0287	<0.001	0.0269	<0.00
Market potential					-0.0175	<0.001	-0.0115	0.001	-0.0077	0.01
Exporter size							0.0008	0.005	0.0011	0.00
Export intensity							0.4357	<0.001	0.2840	0.00
Export intensity × Urban									-0.2215	0.00
Export intensity × Atlantic Canada									0.4155	0.00
Export intensity × Quebec									-0.0994	0.26
Export intensity × Western Canada									0.3321	0.00
Resource-based share									0.1496	0.02
Labour-intensive share									-0.1366	0.07
Product-differentiated share									-0.0582	0.63
Science-based share									-0.0461	0.58
R-squared	0.17	...	0.35	...	0.40	...	0.64	...	0.70	
F (Prob > F)	13.8	<0.001	23.7	<0.001	18.9	<0.001	30.1	<0.001	26.0	<0.00
N	210	...	210	...	209	...	209	...	209	

... not applicable

Notes: P-values are derived from heteroscedasticity-consistent standard errors. The number of observations dropped by one from Model 2 to 3 becau one census division did not have a market potential estimate. Estimating Models 1 and 2 without this observation resulted in no qualitative chan in the estimates. Cells have been left empty when variables are not included in the model.

Source: Statistics Canada, Annual Survey of Manufactures, special tabulation.

Including the size-related variables in Model 2 substantially reduces the effect of the regional differences in specialization (as measured by the regional binary variables). Atlantic Canada's coefficient is about halved and Western Canada's is more than halved. Therefore, the higher levels of industrial specialization experienced by Atlantic Canada and Western Canada are due to a significant degree to the size of their local manufacturing economies and their degree of urbanization.

Model 3 adds the market potential of the census division. Its effect is negative and significant, which suggests location relative to markets—be they here in Canada or in the United States—negatively influences the level of specialization experienced by a census division. Moreover, the inclusion of market potential in the model eliminates most of the variation in the level of specialization across regions.

In total, Models 2 and 3 confirm our expectation that the size of local economies—as measured by manufacturing employment, location in an urban area and market potential—is negatively associated with the level of specialization. Moreover, it is market size that accounts for the variation in the relatively high level of specialization experienced by census divisions in Atlantic and Western Canada. Still to be determined is the effect of export intensity on specialization.

In Model 4, export intensity is introduced. Also included is exporter plant size (exporter size) in order to account for the indirect effect of higher export levels on specialization through larger average plant sizes. There is a strong positive effect of export intensity on specialization, after controlling for exporter plant size, which also has a strong positive effect. Therefore, census divisions that are more export intensive are more industrially specialized, which is consistent with our theoretical expectations regarding the relationship between trade and specialization. Including these two variables had relatively little impact on the level effects of the Atlantic Canada and Western Canada binary variables, but did move the coefficient on Quebec closer to Ontario's level of specialization.[14]

It was hypothesized above that the effect of export intensity on regional specialization may differ across regions and urban and rural areas if the underlying causes of trade also vary across them. Specifically, the effect of trade on specialization might be stronger in Atlantic and Western Canada, as well as in rural areas, because exports from these regions are more likely to be driven by comparative advantage related to their resource endowments. To test this expectation, in Model 5 export intensity is interacted with regional and urban binary variables. Consistent with expectations, for urban census divisions the effect of higher levels of export intensity on specialization is significantly weaker than in rural census divisions. The model also indicates that the effect of higher levels of export intensity on census divisions is stronger in Atlantic Canada and Western Canada than in Ontario. For Quebec, there is no significant difference from Ontario. In short, the effect of trade on specialization was felt most in more resource-reliant rural areas and in Atlantic Canada and Western Canada. This is in contrast to urban areas and census divisions in Ontario and Quebec, whose trade is more likely to be driven by increasing returns to scale, and therefore, is less likely to result in greater industrial specialization.

Also included in Model 5 are the sector shares, with scale-based industries excluded, to account for the effect of industry differences across census divisions. Areas with a larger proportion of resource industries tend to be the most specialized, as one would expect from the theory of comparative advantage.

It is noteworthy that since the variables used in the analysis were calculated across spatial units, parameter estimates and their standard errors may be biased because of spatial dependence in the data. Tests of spatial dependence of the errors for Model 1 (using rook contiguity) indicated spatial dependence was an issue. However, the addition of export intensity to the model (Model 4) eliminated any statistically significant spatial dependence across the errors. This would be consistent with high (and low) levels of export intensity stretching across adjacent census

14. A modified version of Model 4 was also estimated with the regional binary variables (Atlantic Canada, Quebec and Western Canada) excluded. This model—which now includes only the structural variables related to the size of local economies, exporter size and export intensity—provided estimates for these variables that were not qualitatively different from Model 4.

divisions, possibly because resource inputs cross census division boundaries (e.g., access to fishing grounds) or because of shared proximity to international markets (e.g., census divisions that are close to the U.S. border). These high (low) levels of exports would, in turn, be associated with high (low) levels specialization across adjacent census divisions, leading to spatially dependent errors when export intensity is not included in the model.[15] The remaining models presented in the paper include export intensity and their parameter estimates and standard errors are expected to be similarly unaffected by spatial dependence.

The estimates in Table 1 provide us with a picture of the influence of the average of each of the independent variables over the entire study period on the average level of specialization experienced by each census division. However, we do not know whether these relationships have shifted over the study period. To test whether changes have occurred we have divided the analysis into two periods (see Table 2). The first covers the 1970s and 1980s (1974 to 1984) and the second the 1990s (1990 to 1999), roughly the pre- and post-free trade eras.

Model 1 includes controls and the effect of export intensity on specialization and is estimated for both periods. Note first that there was relatively little variation in the coefficients or significance levels for the controls regardless of the period in question. The exception was exporter size. During the 1974-to-1984 period it had no significant effect, but during the 1990s, it had a positive and statistically significant influence on specialization. This suggests that in the 1990s exporters may have become larger and therein contributed to higher levels of specialization.

The effect of export intensity on specialization consistent with industry-based comparative advantage has weakened by the 1990s. In part, this shift may be tied to the growing importance of intra-industry trade between the 1980s and 1990s. The proportion of Canada's trade in manufactured products of the intra-industry variety was 0.61 in 1980, but 0.71 in 1990 and 0.72 in 1999 (Brülhart and Thorpe, 2001). Hence, during the 1974-to-1984 period, intra-industry trade was lower than in the post-1990 period; and this may account for part of the declining effect of export intensity on regional specialization.

The weakened importance of the export intensity variable should not be interpreted as implying the overall impact of trade on specialization has declined over time. Rather the avenue by which trade influences specialization may have changed from specialization driven by industry-based comparative advantage to industry specialization resulting from larger plant sizes. When Model 1 is estimated with exporter size excluded, the coefficient on export intensity remains unchanged over time.[16]

15. This is confirmed by the high degree of spatial dependence observed between the specialization index (dependent variable) and spatially adjacent values for export intensity.
16. For the 1974-to-1984 period, the coefficient on Export intensity was 0.52 (robust standard error = 0.05, t = 11.3), while for the 1990-to-1999 period, the coefficient was 0.47 (robust standard error = 0.05, t = 9.3).

Table 2
Industrial specialization models, 1974 to 1984 and 1990 to 1999, between estimator

	1974 to 1984				1990 to 1999			
	Model 1		Model 2		Model 1		Model 2	
	Coefficient	P-values	Coefficient	P-values	Coefficient	P-values	Coefficient	P-values
Intercept	0.293	<0.001	0.286	<0.001	0.224	<0.001	0.237	<0.001
Atlantic Canada	0.039	0.308	-0.075	0.120	0.069	0.030	-0.128	0.026
Quebec	-0.015	0.524	0.005	0.872	-0.008	0.688	0.019	0.619
Western Canada	-0.025	0.453	-0.103	0.008	0.004	0.885	-0.136	0.003
Urban	-0.186	<0.001	-0.135	<0.001	-0.184	<0.001	-0.089	0.008
Employment	-0.030	<0.001	-0.029	<0.001	-0.029	<0.001	-0.026	<0.001
Employment × Urban	0.030	<0.001	0.029	<0.001	0.028	<0.001	0.026	<0.001
Market potential	-0.011	0.007	-0.008	0.062	-0.012	<0.001	-0.008	0.023
Exporter size	0.0004	0.425	0.0006	0.183	0.0010	0.002	0.0012	<0.001
Export intensity	0.494	<0.001	0.364	<0.001	0.368	<0.001	0.198	0.023
Export intensity × Urban			-0.174	0.045			-0.199	0.005
Export intensity × Atlantic Canada			0.255	0.025			0.412	0.002
Export intensity × Quebec			-0.083	0.410			-0.070	0.439
Export intensity × Western Canada			0.236	0.018			0.357	0.002
Resource-based share			0.126	0.115			0.104	0.116
Labour-intensive share			-0.152	0.075			-0.153	0.036
Product-differentiated share			-0.091	0.450			-0.064	0.572
Science-based share			-0.007	0.950			-0.080	0.305
R-squared	0.63	...	0.67	...	0.60	...	0.66	...
F (Prob>F)	33.0	<0.001	24.1	<0.001	24.9	<0.001	22.3	<0.001
N	209	...	209	...	209	...	209	...

... not applicable

Notes: P-values are derived from heteroscedasticity-consistent standard errors. Cells have been left empty when variables are not included in the model.

Source: Statistics Canada, Annual Survey of Manufactures, special tabulation.

Model 2 expands on Model 1 by including a set of regional interaction terms. Comparing the results across the two time periods, and focusing on the export intensity interaction terms, the primary change is the declining influence of export intensity on specialization in Ontario and Quebec and in urban areas. Note that the effect of each of the regional interaction terms is measured relative to the excluded category, which is rural Ontario. The effect of export intensity on rural areas in Ontario declines between the two periods, such that by the 1990-to-1999 period it is only significant at the 12% level. The parameter estimates on the interaction terms for Urban and Quebec remain constant, and hence their effect has declined between the two periods. On the other hand, although the parameter estimates for Atlantic Canada and Western Canada increase, there is little change in their influence because the declining coefficient on Export Intensity effectively mitigates their increase.

5. *Dynamic analysis*

The identification of the effect of export intensity on specialization in the models presented to this point has relied on cross-sectional variation. This obviously provides information on how export intensity is associated with the level of specialization experienced by a region, but the cross-sectional analysis does not provide information on how changing levels of export intensity have influenced specialization over the study period. In particular, the cross-sectional analysis does not address the question of why no increase in specialization is observed as regions have become more integrated into world markets through trade.

Table 3 reports the results of a model that estimates the effect of a change in export intensity on the change in the level of specialization from 1974 to 1990 and from 1990 to 1999. Model 1 includes only exporter size, export intensity and an intercept term. The latter provides a measure of whether there has been an increase or decrease in the level of specialization independent of changes in other variables (see Equation [1.3]). The effect of exporter size is insignificant in the first period but highly significant in the second, suggesting that the role of exporter size as a driver of specialization increased over the period. Paralleling the cross-sectional results, there is a positive relationship between export intensity and specialization and the effect of export intensity tends to fall over time (see Tables 2 and 3). However, the coefficients on export intensity derived from the first-difference model are much smaller than the coefficients derived from the cross-sectional model and are only weakly significant. This is consistent with the descriptive analysis that suggested there was little relationship between increases in export intensity and specialization.

To test these results further, the change in total (manufacturing) employment and total employment interacted with whether the census division is classified as urban are added for Model 2. This model parallels Model 4 from Table 1 and Model 1 from Table 2, with those regressors that are fixed across time excluded. There is little change in the coefficients on exporter size or export intensity. With respect to the added controls, during the first period there is a weakly significant negative relationship between increases in employment in rural areas and changes in specialization. This suggests in this period there was a tendency for rural regions to increase employment in sectors in which they were not specialized, resulting in less specialization. In the second period, however, we see a complete reversal in the relationship. During this time, rural areas appear to be increasing their employment in sectors in which they were already specialized. In urban areas in both periods, there is no significant influence of changes in manufacturing employment on their change in specialization.

As noted in the introduction, a lower coefficient on export intensity when estimated using change rather than levels of the dependent and independent variables would be consistent with a world where comparative advantage is shifting from more to less important industries as measured by employment. To raise the confidence that we place on this interpretation, the remainder of this section focuses on developing more direct evidence of shifting comparative advantage.

Table 3
Change in specialization as a function of a change in export intensity

	1974 to 1990				1990 to 1999			
	Model 1		Model 2		Model 1		Model 2	
	Coefficient	P-values	Coefficient	P-values	Coefficient	P-values	Coefficient	P-values
Constant	-0.013	0.277	-0.014	0.265	-0.030	<0.001	-0.032	<0.001
Δ Exporter size	0.0004	0.421	0.0004	0.412	0.0006	0.001	0.0006	<0.001
Δ Export intensity	0.170	0.082	0.179	0.078	0.067	0.098	0.057	0.163
Δ Total employment			-0.011	0.115			0.010	0.043
Δ Total employment × Urban			0.011	0.112			-0.010	0.068
R-square	0.05	...	0.06	...	0.08	...	0.10	...
F (Prob > F)	2.15	0.12	1.24	0.294	7.91	0.001	5.66	<0.001
N	210	...	210	...	210	...	210	...

... not applicable

Notes: P-values are derived from heteroscedasticity-consistent standard errors. Cells have been left empty when variables are not included in the model.

Source: Statistics Canada, Annual Survey of Manufactures, special tabulation.

Whether an increase in export intensity leads to an increase in the level of specialization depends on two conditions. The first condition is whether the increase in a sector's export intensity coincides with an increase in its employment share.

This condition can be tested by correlating the change in export intensity with the change in employment shares by sector across census divisions. To this end, each census division is divided into the five sectors that correspond to those used as controls in the regression analysis. These sectors were chosen because they group industries that rely on different factors of production to create their comparative advantage. As a reminder, these factors include: access to natural resources inputs (resource-based industries), access to abundant labour (labour-intensive industries), access to capital (scale-based industries), marketing, and production know-how (product-differentiated industries), and scientific and other forms of knowledge (science-based industries). The periods chosen for the correlations are 1974 to 1990 and 1990 to 1999, which correspond to the periods used in cross-sectional and first-difference analyses.

As expected, the correlations show a positive association between changes in export intensity and changes in sectoral employment shares. The correlation between a change in export intensity and a change in employment share is 0.17 in the 1974-to-1990 period and 0.10 in the 1990-to-1999 period.[17] This positive association between increasing export intensity and employment shares does not necessitate an increase in specialization, however. For this outcome to occur, the second condition must also hold.

17. Both correlations are significant at the 0.01 level or below.

The second condition is whether this increasing employment stimulated by growing export intensity occurs in an industry that accounts for a large share of the local economy relative to the other sectors.[18] Our expectation based on the Rybczynski theorem (see Wong, 1995) is that sectors that have a comparative advantage will be relatively large. Hence growing trade should result in the expansion of sectors that are already important to the local economy. Even if we consider a world characterized by dynamic, rather than static, comparative advantage, we would expect a region to specialize in the sector in which it has an initial comparative advantage as the dynamic economies 'lock-in' this advantage (see Grossman and Helpman, 1991 and Brasili, Epifani and Helg, 2000). Together, these theoretical propositions imply the following hypotheses:

> H1: *The export intensity of a sector is positively associated with its share of regional employment*; and
> H2: *The change in export intensity over time is positively associated with its initial level.*

If H1 and H2 hold, then rising export intensity should be positively associated with a sector's initial level of employment. This, in turn, should increase the effect of rising export intensity on industrial specialization.

As noted in the introduction, there is an alternative view based on the proposition that the sources of comparative advantage can shift over time. Comparative advantage can emerge through entrepreneurship, investments in human and physical capital, and as the prices or the costs of exploiting resources change. Comparative advantage can also be lost as a result of technological change or the exhaustion of a resource base, among other factors. From this perspective, comparative advantage may ebb in industries where it was once strong and flow to industries where it was once weak. This implies the following hypothesis, which is the exact opposite of H2:

> H2′: *The change in export intensity over time is negatively associated with its initial level.*

If H1 and H2′ hold, then rising export intensity should be negatively associated with a sector's initial level of employment. This, in turn, should diminish the effect of rising export intensity on specialization.

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18. To see the effect of a growing share of employment in a sector on the industry specialization (IS) index, consider the total differential of the index: $dIS = 2\left(s_1 ds_1^2 + \sum_{i=2}^{n} s_i ds_i^2 \right)$, where we assume only sector 1 has increased its level and share of employment, while all other sectors i maintain a constant level of employment and hence decline in their shares. Since these remaining sectors experience declining shares, the summation of their share-weighted changes in their squared shares must be negative. Therefore, an increasing share of sector 1 will only result in an increase in the IS index if its value is larger than that of the summation term. This is more likely the larger the share of sector 1. It is also more likely the more evenly employment is shared across the remaining sectors and the greater the number of sectors.

Table 4
Correlations

	Change in export intensity	Export intensity (1974 or 1990)
Panel A: 1974 to 1990		
Export intensity in 1974	-0.33	...
Sectoral share of employment in 1974	-0.08	0.53
Panel B: 1990 to 1999		
Export intensity in 1990	-0.47	...
Sectoral share of employment in 1990	-0.18	0.52

... not applicable
Note: All correlations are significant at the 5% level or below.
Source: Statistics Canada, Annual Survey of Manufactures, special tabulation.

Table 4 presents a set of correlations intended to test these three hypotheses. Across census divisions in 1974 and 1990, there is a strong positive and significant association between their sectors' share of employment and export intensity (see Table 4). This positive association is consistent with H1. Also reported in Table 3 is the correlation between the initial level of export intensity of a sector in 1974 and 1990 and its change in the ensuing period. Here there is a strong and significant negative correlation in the first and, especially, the second period. This finding is consistent with H2′ (and by definition inconsistent with H2). There is a tendency for comparative advantage to ebb in sectors in which a region initially had a comparative advantage and flow to industries where this advantage was weaker.

Given that both H1 and H2′ hold, there may be a negative associated between initial employment shares of a sector and its change in export intensity. This is tested directly by correlating employment shares with the change in export intensity. There is a negative and significant association for 1974 and 1990 (see Table 4). This negative association is particularly strong in the post-1990 period. Hence, the growth in export intensity is weaker in those sectors that account for a higher share of employment.

In total, the result from Table 3 suggests there is a tendency for comparative advantage to shift from more to less important sectors, which would tend to diminish the effect of increases in export intensity on industrial specialization. This helps to explain the relatively weak association between export intensity and specialization that we observe in the first-difference model. Given that the negative association between export intensity and employment shares is particularly strong after 1990, this may also help to explain the declining association between levels of export intensity and specialization in the cross-section after 1990.

The results, to this point, suggest comparative advantage does appear to shift at a relatively rapid pace across sectors. This shift may have a geographic expression, as locations that once had relatively high export intensities in a sector fall relative to those that started with relatively low export intensities. To explore this, a transition matrix was constructed for each of the five sectors, using 1974 as the start point and 1999 as the end point. For a given sector, export intensities in 1974 and 1999 are ranked across census divisions and divided into quartiles. If a sector's export intensity remains in the 1st quartile in both 1974 and 1999, it is classified into the

top, left-hand cell of the table. If over the period, the sector's ranking fell from the 1st quartile to the 2nd, 3rd, or 4th, it is placed into these cells along the row. For instance, of the 52 census divisions whose natural resource-based export intensity ranked in the 1st quartile in 1974, 29 remained in the 1st quartile, while 12 moved to the 2nd, 7 to the 3rd, and 4 to the 4th. The diagonal "boxed" cells include sectors that did not move up or down in their quartile ranking, while the off-diagonal to the north and east indicate a sector fell in its ranking and the off-diagonal cells to the south and west include sectors that rose. We also include in the table, two summary measures of change: total change and 2Q+ change. The 'total change' measure represents the sum of observations that fall into the off-diagonal cells as a share of all observations. If all sectors changed their quartile ranks, 'total change' value would equal 100%. Since a small change in relative export intensity can cause a shift between adjacent quartiles (e.g., from the 2nd to 3rd), we also include the 2Q+ change, which measures the proportion of sectors that shifted two or more quartiles (e.g., from 1st to 3rd).

It is evident from Table 5 that there is considerable movement over time. About 60% or more sectors move between quartiles. Using the more restrictive 2Q+ measure of change, we also see strong movement. Labour-intensive sectors see the most change, with about 30% moving two or more quartiles in their ranking, while for the other sectors about 20% change, with the least change occurring in scale-based and product-differentiated industries.

These changes in quartile ranks translate into relatively large shifts in export intensity. As an example, consider scale-based industries. For the 18 census divisions that were found in the 2nd quartile in 1974 but the 1st quartile in 1999, their export intensity increased from an average of 35% in 1974 to 74% in 1999. On the other hand, for the 14 census divisions ranked in the 1st quartile in 1974 but fell to the 2nd quartile in 1999, their average level of export intensity fell from 80% to 50%. This pattern is generally repeated across all sectors (see Appendix A).

The broad conclusion to be drawn from the correlation and transition matrix analyses is that a region's comparative advantage tends to shift from sector to sector and from region to region. This ebb and flow of comparative advantage dampens the effect of increasing export intensity on specialization. In this sense, the tendency for trade to lead to greater specialization, which we see so clearly in the cross-sectional analysis, is constantly being undermined by the fact that the sources of comparative advantage of regional economies appear to be ever changing.

Table 5
Sectoral export intensity transition matrices, 1974 and 1999

Natural resource-based

1974 Quartile	1999 Quartile 1st	2nd	3rd	4th	Total
1st	**29**	12	7	4	52
2nd	11	**15**	16	11	53
3rd	7	16	**17**	13	53
4th	5	10	13	**24**	52
Total change			60%		
2Q+ change			21%		

Labour-intensive

1974 Quartile	1999 Quartile 1st	2nd	3rd	4th	Total
1st	**12**	19	12	6	49
2nd	16	**15**	13	6	50
3rd	4	4	**6**	1	15
4th	17	12	19	**36**	84
Total change			65%		
2Q+ change			29%		

Scale-based

1974 Quartile	1999 Quartile 1st	2nd	3rd	4th	Total
1st	**25**	14	7	6	52
2nd	18	**19**	8	7	52
3rd	4	13	**20**	15	52
4th	5	6	17	**24**	52
Total change			58%		
2Q+ change			17%		

Product-differentiated

1974 Quartile	1999 Quartile 1st	2nd	3rd	4th	Total
1st	**20**	13	11	3	47
2nd	14	**14**	12	5	45
3rd	13	20	**25**	39	97
Total change			69%		
2Q+ change			17%		

Science-based

1974 Quartile	1999 Quartile 1st	2nd	3rd	4th	Total
1st	**14**	13	4	4	35
2nd	6	**9**	5	4	24
3rd	15	13	**19**	35	82
Total change			70%		
2Q+ change			19%		

Notes: For the Product-differentiated and Science-based sectors only three quartiles are reported for 1974. This results from the larger number of zero export intensity values that produce a larger number of tied observations with the same (low) rank. The 'total change' measure represents the sum of observations that fall into the off-diagonal cells as a share of all observations. The '2Q+ change' measures the proportion of sectors that shifted two or more quartiles.

Source: Statistics Canada, Annual Survey of Manufactures, special tabulation.

6. *Conclusion*

Over 25 years, Canada's manufacturing sector more than doubled its level of export intensity. But with this growing integration we have not observed an associated increase in specialization at the regional scale. Much of the analysis developed in this paper has attempted to answer why this is so.

Across regions, higher levels of export intensity are positively associated with higher levels of industrial specialization, particularly in rural areas, Western Canada, and the Atlantic Provinces. These are economies that tend to be more closely tied to their natural resource bases than urban areas or Ontario and Quebec. For the latter regions, trade may be driven more by specialization in varieties of goods across plants rather that specialization across industries.

The association between trade and specialization so evident in the cross-sectional analysis is much weaker when we begin to look at the effect of changes in export intensity on specialization. This weakness appears to be related to the tendency for comparative advantage to shift from more to less important sectors within regional economies, particularly after 1990. Therefore, although in the long-run trade does appear to be associated with higher levels of specialization, the tendency for comparative advantage to ebb and flow from sector to sector appears to mitigate the effect of rising trade on specialization.

Appendix A Export intensities by quartile rank in 1974 and 1999

Table A.1
Sectoral average export intensity by cross-tabulated quartile ranks from 1974 and 1999

Natural resource-based

		1999 Quartile							
		1st		2nd		3rd		4th	
		1974	**1999**	**1974**	**1999**	**1974**	**1999**	**1974**	**1999**
1974 Quartile	1st	0.40	0.59	0.40	0.30	0.35	0.16	0.33	0.04
	2nd	0.07	0.50	0.07	0.25	0.06	0.14	0.07	0.04
	3rd	0.01	0.52	0.02	0.26	0.02	0.15	0.02	0.05
	4th	0.00	0.63	0.00	0.25	0.00	0.14	0.00	0.03

Labour-intensive

		1999 Quartile							
		1st		2nd		3rd		4th	
		1974	**1999**	**1974**	**1999**	**1974**	**1999**	**1974**	**1999**
1974 Quartile	1st	0.16	0.44	0.13	0.25	0.12	0.06	0.20	0.00
	2nd	0.02	0.43	0.02	0.24	0.02	0.08	0.02	0.00
	3rd	0.00	0.44	0.01	0.24	0.00	0.05	0.00	0.00
	4th	0.00	0.46	0.00	0.22	0.00	0.05	0.00	0.00

Scale-based

		1999 Quartile							
		1st		2nd		3rd		4th	
		1974	**1999**	**1974**	**1999**	**1974**	**1999**	**1974**	**1999**
1974 Quartile	1st	0.75	0.70	0.80	0.50	0.74	0.32	0.75	0.09
	2nd	0.35	0.74	0.36	0.51	0.33	0.33	0.35	0.07
	3rd	0.13	0.67	0.10	0.50	0.11	0.32	0.11	0.09
	4th	0.00	0.75	0.02	0.46	0.01	0.30	0.00	0.06

Product-differentiated

		1999 Quartile							
		1st		2nd		3rd		4th	
	Year	**1974**	**1999**	**1974**	**1999**	**1974**	**1999**	**1974**	**1999**
1974 Quartile	1st	0.20	0.56	0.24	0.35	0.24	0.13	0.40	0.00
	2nd	0.04	0.55	0.02	0.32	0.03	0.14	0.03	0.00
	3rd	0.00	0.57	0.00	0.32	0.00	0.11	0.00	0.00

Science-based

		1999 Quartile							
		1st		2nd		3rd		4th	
		1974	**1999**	**1974**	**1999**	**1974**	**1999**	**1974**	**1999**
1974 Quartile	1st	0.26	0.65	0.15	0.31	0.17	0.08	0.31	0.00
	2nd	0.02	0.55	0.02	0.29	0.02	0.05	0.02	0.00
	3rd	0.00	0.78	0.00	0.31	0.00	0.04	0.00	0.00

Source: Statistics Canada, Annual Survey of Manufactures, special tabulation.

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